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Recent Experimental Results from National Spherical Torus Experiment

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ornl



UCLA



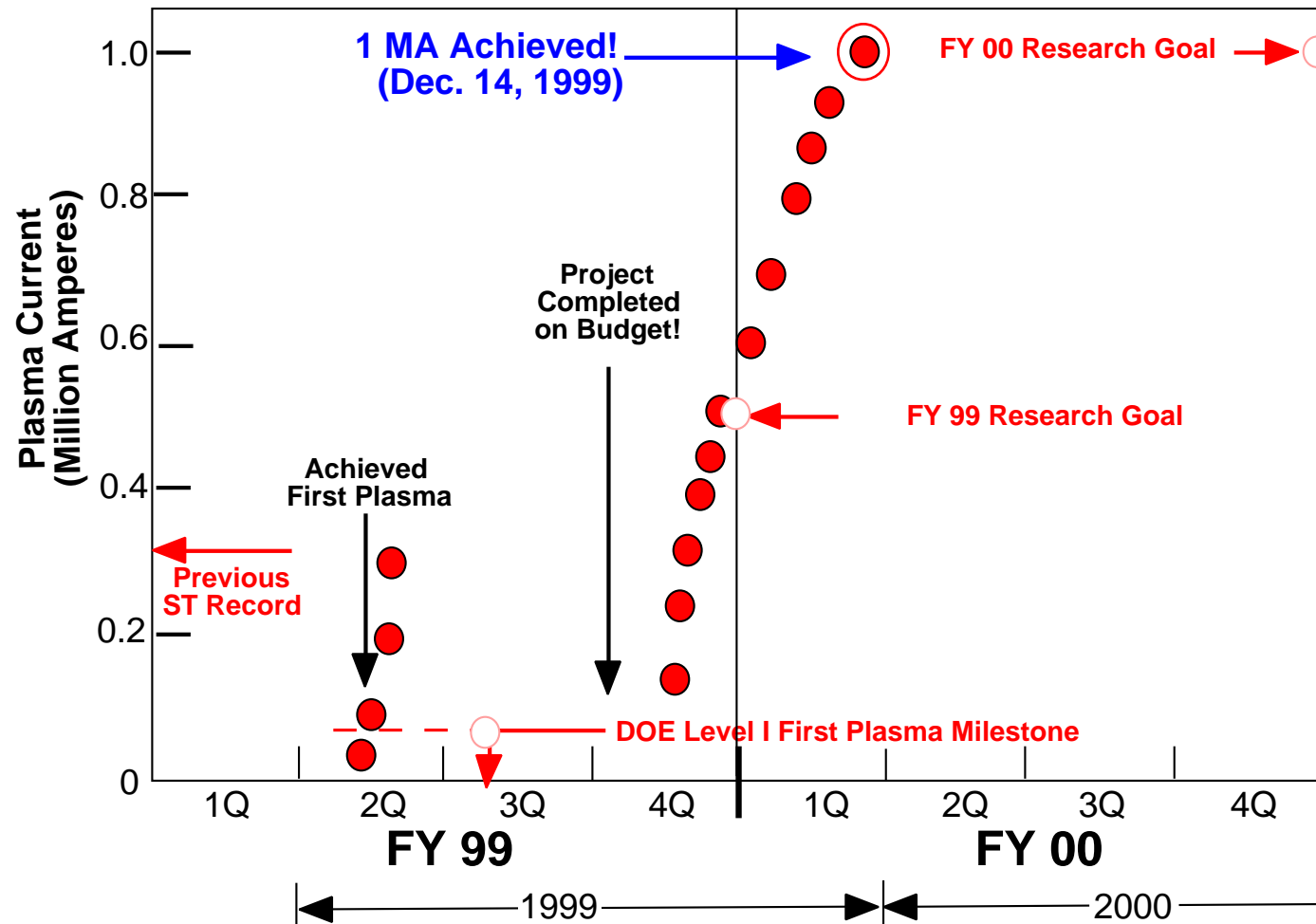
ICC Conference, Berkeley, Calif.,
Feb. 22 - 24, 2000

FACILITY AVAILABILITY IMPROVING

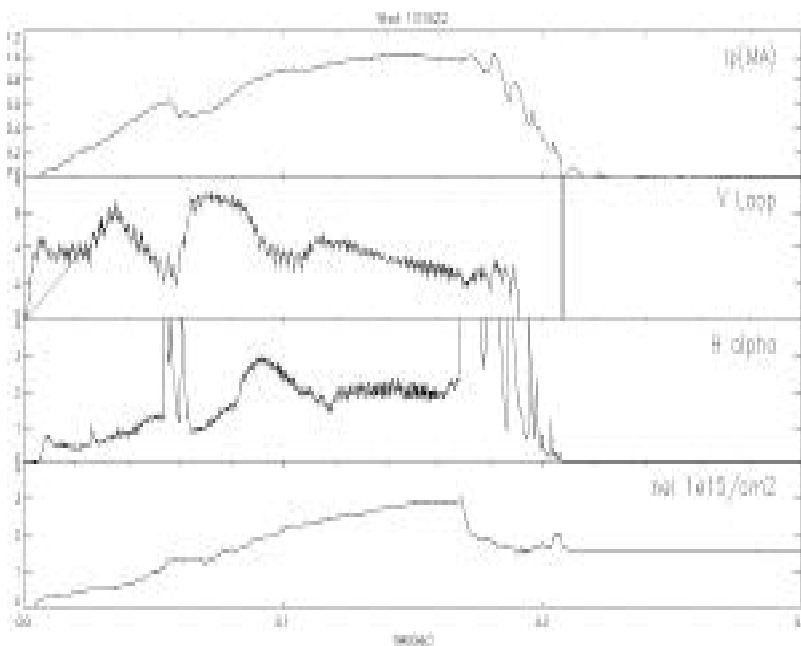


- NSTX Torus Facility is performing close to the original specification
 - TF Coils operated routinely at 3 kG. 6 kG operation will start in the summer of 00.
 - All PF Coils were tested to full rating of 20 kA.
 - OH operated routinely at full rating with +, - 24 kA at 6 kV.
 - GDC worked reliably including the between-shots He GDC. (H. Kugel)
 - Bakeout system brought Center Stack tiles to 300 °C and VV to 150 °C.
 - EPICS Engineering Control System, MDS-PLUS Data Acquisition System and Real-time Plasma Control System are working well.
- Good progress in Research Operations and XP Implementations

One Million Amperes Achieved on NSTX!

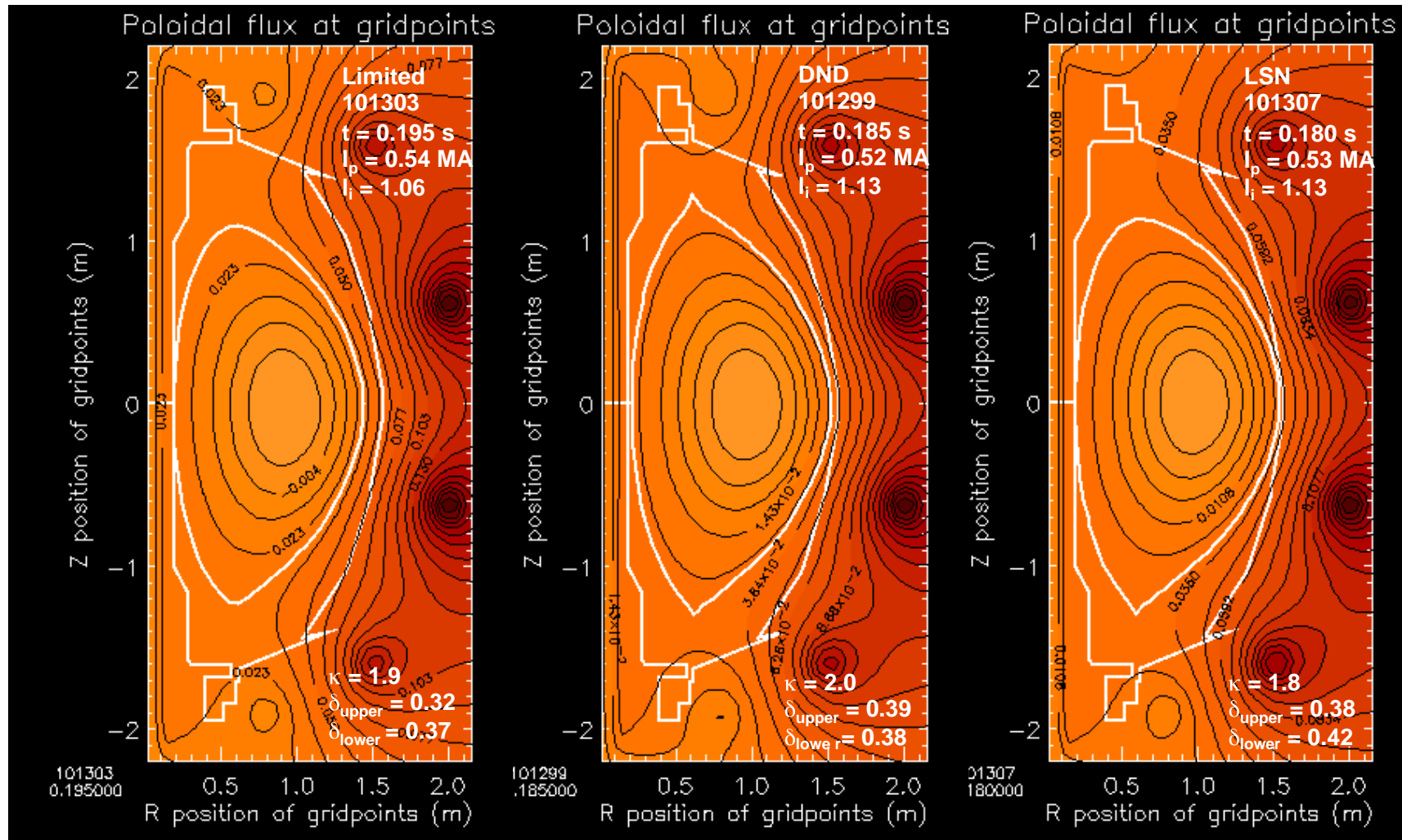


ACHIEVED 1 MA MILESTONE



- 1 MA Ohmic Plasma Current reached even with some “hesitation”.
- Position controlled in feedback mode
- Stored energy and plasma beta go up nicely with plasma current.

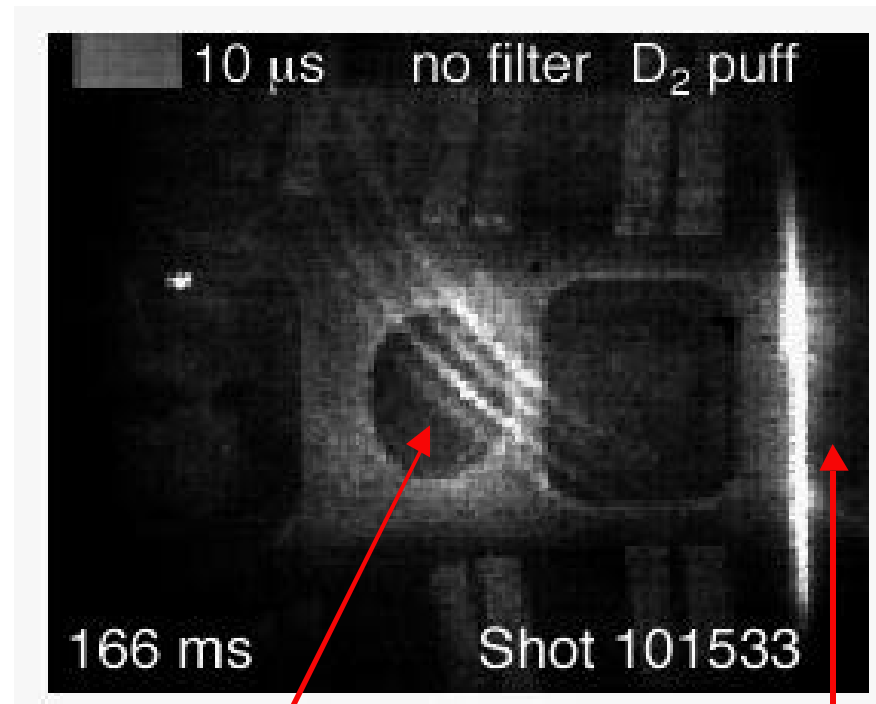
NSTX Limited, DND and LSN Ohmic Plasmas



Macroscopic edge turbulence is being examined

■ Turbulence Imaging

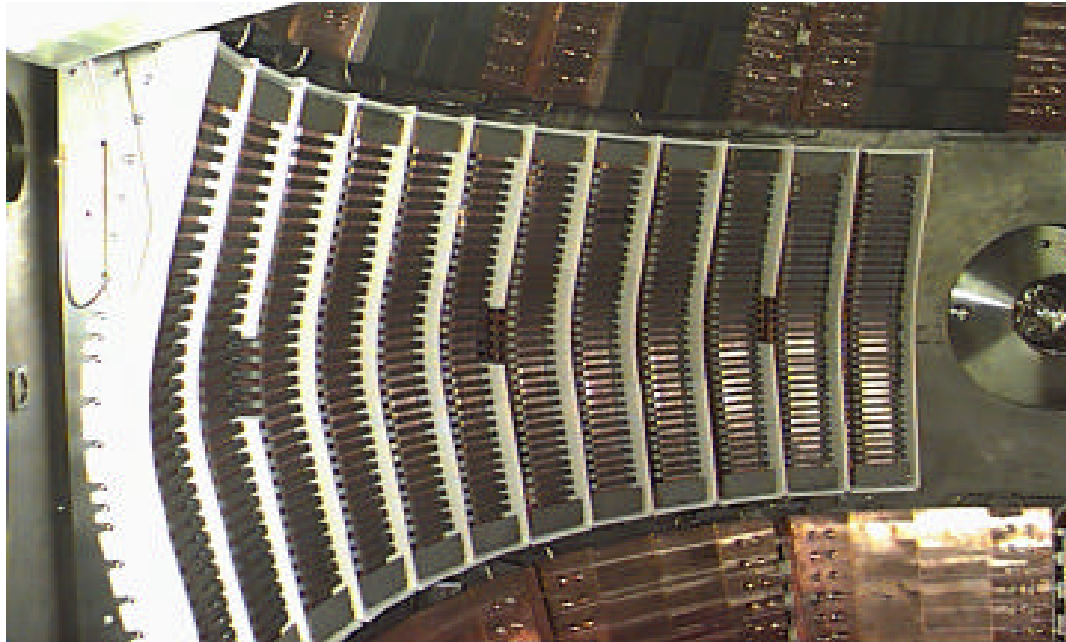
- n_e fluctuations -
characterize cross-field
scale lengths / frequency
spectra
- filamentation observed
with orthogonal camera
view
- poloidal wavelength - 10-
15cm (\sim gas puff size)
- tangential field line view
yields 'blinking' eddies
 - present size of puff \sim
eddy size



edge turbulence filaments

inboard limiter

High Harmonic Fast Wave Plan

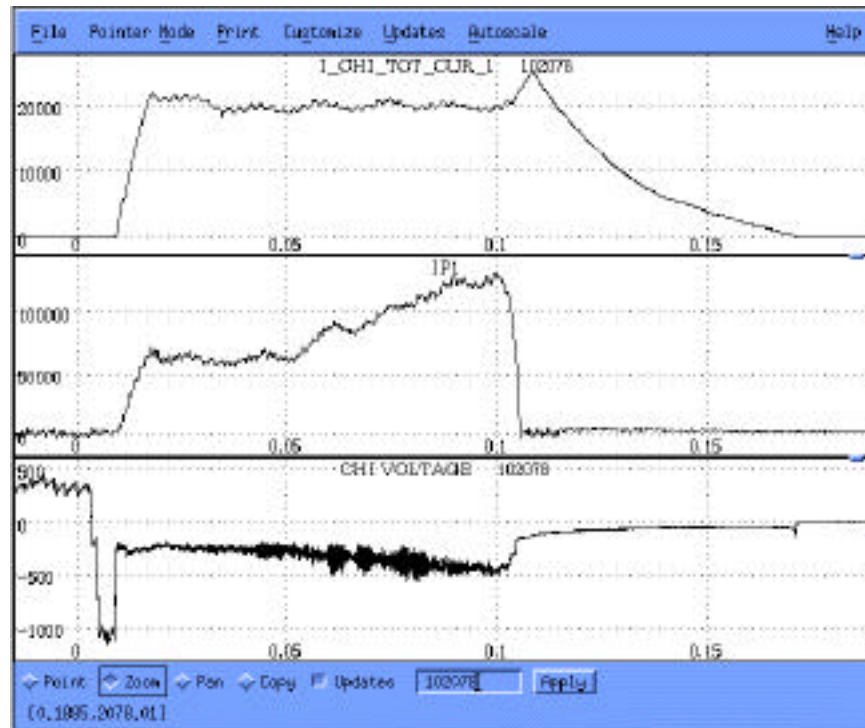


Enabling Technology
PPPL-ORNL Collaboration

HHFW Physics Team includes
PPPL, ORNL, GA, UCSD, MIT

- Achieved 2 MW. Observed plasma loading agrees with calculated value using ORNL reflectometry edge density profile. Core electron heating observed.
 - Full 12 antenna – 6 transmitter real-time-phasing configuration implemented for the next run. 4MW in FY 00 and 6 MW in FY01.

CHI is starting to work! (R. Raman at this Conference)



A new class of CHI experiment has started.

- Up to 130 kA plasma discharges obtained with 20 kA CHI injection,
- The CHI ceramic insulators lasted through the campaign.
- 50 kA injection (to achieve 200 kA) during the next campaign.

NSTX National Research Team is working well!



- **Columbia University, 3-D Wall Currents Modeling** made a significant impact and **EFIT/MHD** effort coming together nicely.
- **LANL Fast Camera**, the workhorse of the plasma operations.
- **ORNL ECH Preionization** system working reliably for OH and CHI.
- **ORNL HHFW** collaboration, a shining example of enabling technology collaboration. **Edge Reflectometry** measured the edge density profiles.
- **ORNL** Boundary physics collaboration helped evaluate wall conditioning.
- **University of Washington**, leading the **CHI** research very nicely. Excellent synergy with HIT-II! **GA** is developing a nice analysis tool for **CHI**.
- **Johns Hopkins University Ultra-Soft X-ray system** is working well and yielding important results (e.g. electron heating during HHFW).
- **GA Real Time Control System** collaboration invaluable for plasma operations.
- **UCLA Reflectometry** is yielding data.
- **RF Collaboration effort (MIT, GA and UCSD)** are preparing important tools for EBS and HHFW.
- **SNL's Diagnostic Tiles** have been installed and being analyzed after the run.
- **LLNL(Edge Physics), UCD(FIR), and FP&T (MSE)** are addressing the longer-term needs.



Facility Utilization



NSTX

Facility Plasma Operations Availability

| | FY 99 | FY 00 | FY 01 | FY 02 |
|----------------|-------|------------|-------|-------|
| # of run weeks | 5* | 14 (10*) | 13 | 13 |
| # of hours | 110* | 560 (420*) | 520 | 520 |

* actual to date

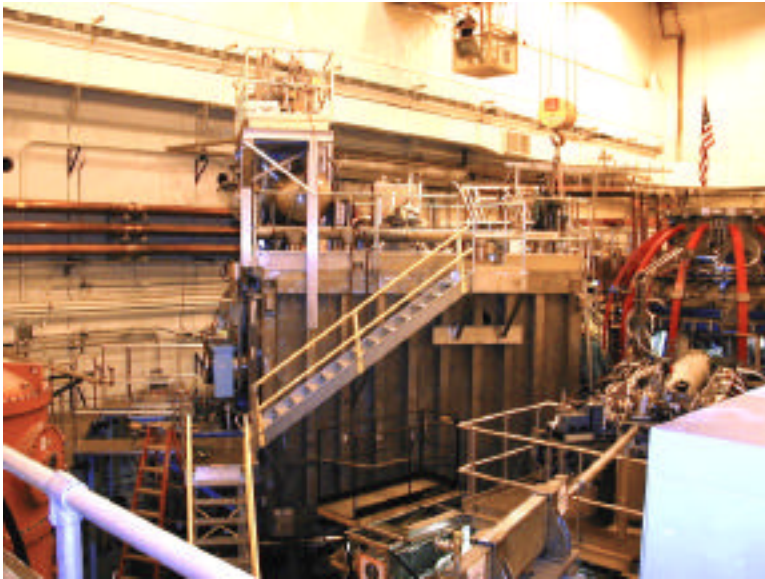
Research Personnel

| | PPPL | non-PPPL |
|----------------|------|----------|
| Researchers | 49 | 48 |
| Grad. Students | 6 | 6 |

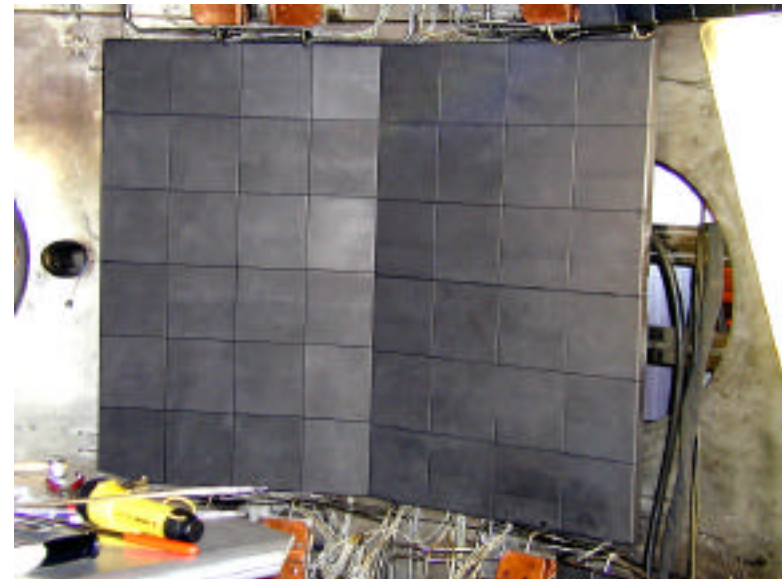
Visiting Scientists

| | |
|-----------------------------|----|
| Visiting US Scientists | 20 |
| Visiting Foreign Scientists | 20 |

NBI Installation Making Excellent Progress



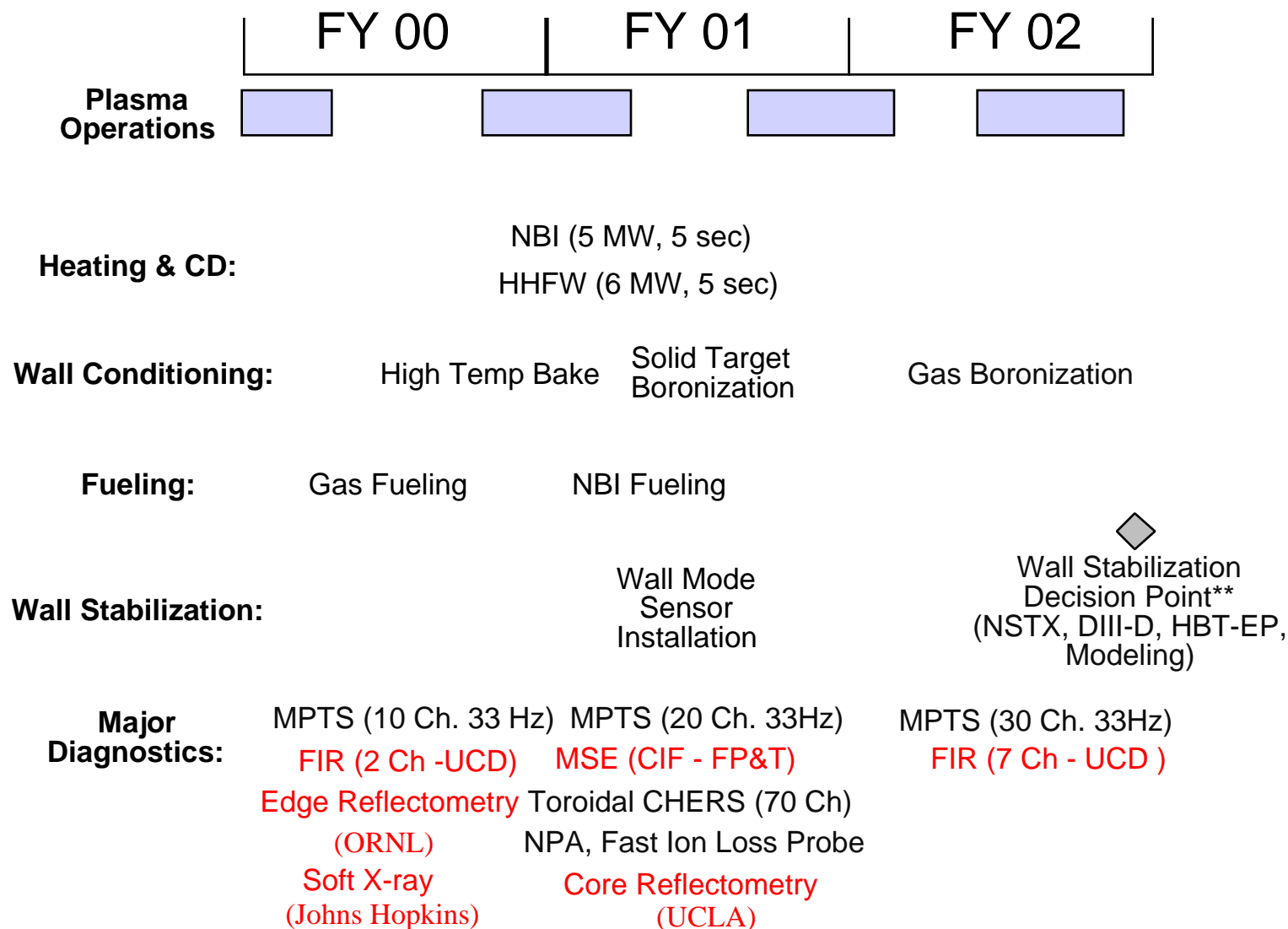
NBI under construction



NBI protective armor inside NSTX

- Vacuum system pump down in July; Conditioning in Aug. – Sept.
- Injection into plasma in Oct. 2000.
- 70 Channel CHERS system in Oct. 2000 and MSE in May 2001.

FY 00- 02 Base Budget Facility Plan



SUMMARY OF NSTX PROJECT ACTIVITY



- Plasma operations in Oct. 99 – Jan 00 have been quite productive.
- All indications are good thus far! Achieved 1 MA “ST world record” discharges. Good performance trend with current and plasma density.
- HHFW and CHI are starting to work.
- Diagnostics are ramping up. [MPTS, CHERS, MSE (FP&T), FIR Int.(UCD), Reflectometry (UCLA, ORNL), X-Ray(Johns Hopkins)....]
- Strong National Research Team is working together very well.
- Exciting time is ahead with NBI and many new capabilities;
- Innovative ideas presented at recent NSTX Research Forum for CT related research: Spherical RFP, Merging Spheromaks, FRC, CT Injection..